ANALYSIS OF MIDDEN FROM TWO SITES ON MOTUTAPU ISLAND, NEW ZEALAND

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Abstract. Midden material from sites N38/37 and N38/30 consisted of shells and fishbones. At site N38/37 pipi shells, *Amphidesma australe,* were most common, while at N38/30 tuatua, *A. subtriangulatum,* were more important. This difference is probably due to separation in time. The main fish was snapper, *Chrysophrys auratus,* with head bones represented more frequently in the midden than body bones.

This paper describes midden material from sites N38/37 and N38/30 on neighbouring hills at Station Bay, on the east coast of Motutapu Island. The sites were excavated in the Christmas holidays of 1967 (Davidson, Leahy, this volume). Both N38/37 and N38/30 are terraced pit sites about 200 yards (182 m) back from Station Bay beach.

The midden contained mostly shells and fishbones, and gave evidence of exploitation of an area which covered at least a mile (1.6 km) to the north and three miles (4.8 km) to the south-west. In this area there are five types of marine environment, differing in range and number of available food species.

1. The first is the Station Bay beach. This consists of large smooth pebbles, and is a poor source of food because the smooth surfaces of the stones and the constant movement from wave action discourage the growth of large edible molluscs.

2. The nearest sources of sea foods are the rocky headlands at either end of the beach. Present day shellfish found on the headlands are all typical rocky shore species: periwinkles, *Lunella smaragda;* limpets, *Cellana* sp.; small gastropods such as *Zediloma* and *Cominella,* and larger rock gastropods such as *Neothais scalaris* and *Haustrum haustorium.* The rock oyster, *Crassostrea glomerata,* is rare, although found extensively on rocky outcrops further south. Mussels, *Perna canaliculus,* are small and sparse: this may be the result of an earlier period of over-exploitation, as conditions on the headland seem favourable to mussel growth.

   This pattern of stony beaches and rocky headlands extends some distance north and south of Station Bay.

3. A third type of environment is the sheltered, rather muddy, soft beaches on the eastern and south-eastern coast of Motutapu, from which can be obtained cockles and pipi. The shallow muddy estuary between Rangitoto and Motutapu Islands, three miles (4.8 km) from Station Bay, is a particularly rich source of these molluscs.

4. On the more exposed sandy beaches on the north coast of Motutapu tuatua are found.

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5. The fifth type of marine environment open to economic exploitation from Station Bay is the offshore fishing ground. Station Bay is situated on a good fishing ground: the offshore sea bottom is a muddy platform, which eventually grades into the hard shelly substratum which lies in all the main channels of the Waitemata Harbour (Powell 1937). This muddy platform is rich in marine life, and nearly a third of the diet of the snapper is made up of species found here.

Station Bay, then, is situated in a locality which is favourable for the exploitation of fish, especially snapper.

Method of Analysis

The midden material from site N38/30 represents the total material recovered in the course of the excavation; that from site N38/37 represents all the material except a little of the midden from square M-11 which was excavated toward the end of the dig when time was short. The distribution of midden in the excavations at site N38/37 is shown in Fig. 1.

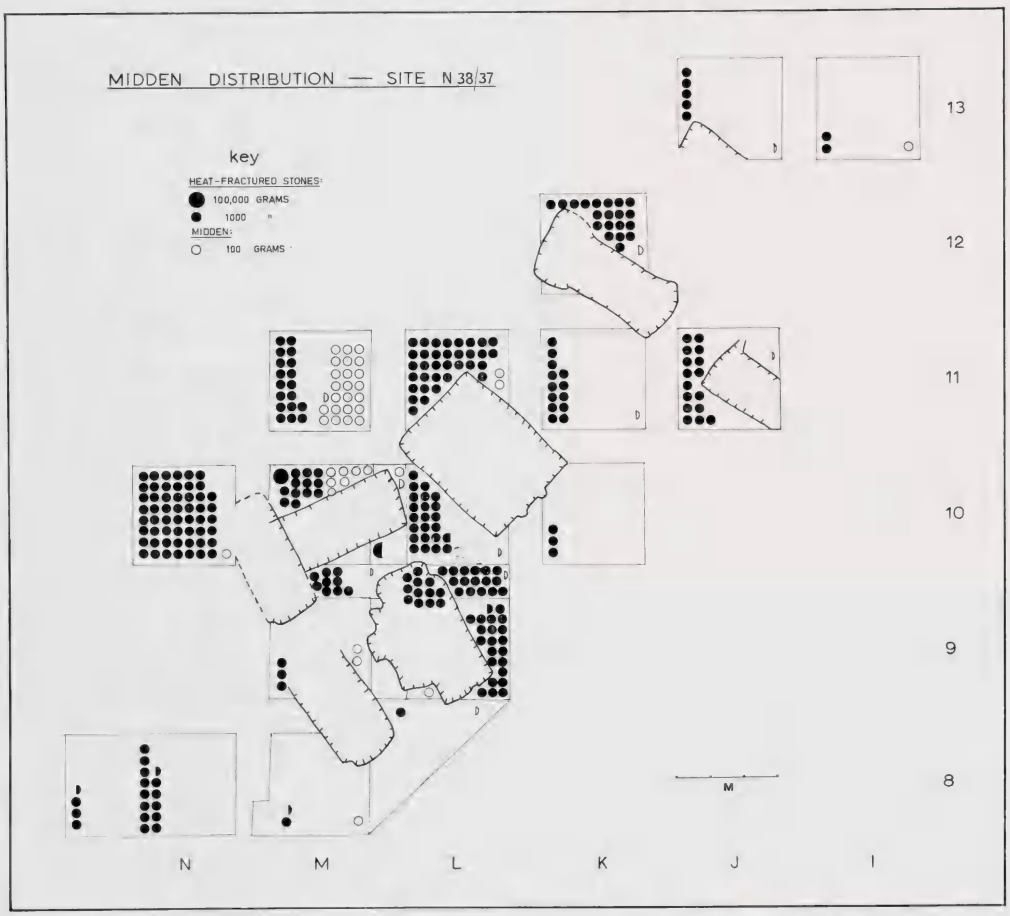

Fig. 1. Distribution of midden, site N38/37, Station Bay, Motutapu Island.

Shells were weighed, identified, counted and, in the case of cockles, graded according to size (greatest diameter). Bivalves were counted only when they had a hinge, and gastropods when the spire was intact.

Processing of fishbones followed roughly the procedure described by Shawcross (1967, pp. 111-4). They were sorted according to bone type and, where possible, were identified by means of a comparative collection of all the common North Island edible fish. All the fish of the comparative collection had been weighed and measured (total length, standard length, head length, snout length) before being reduced and, by a calculation based on a comparison of the right dentaries (the most common bone in the midden material), the approximate size and weight of the snapper present in the midden were obtained.

Length was calculated according to simple proportion. The formula is:

lx = dentary length (midden material),
Lx = unknown length of fish (midden material),
ls = dentary length (comparative collection),
Ls = known length of fish (comparative collection).
$Lx = (lx \cdot Ls)/(ls)$. Length given is total length.

In calculating the weight of fish from midden material, it has been assumed (Shawcross 1967, p. 114) that a change in the linear dimension of a fish results in a volumetric change (and hence weight change) proportional to the cube of the linear change. Cassie (1957, p. 387) found, however, that the weight of snapper is proportional to the 2.69th power of the length. Thus the weight of snapper in the midden has been calculated as follows (suffixes as above):

$$(Lx)^{2.69}/(Ls)^{2.69} = (Wx)/(Ws)$$
$$\therefore \quad Wx = (Ws \cdot lx^{2.69})/(ls^{2.69})$$
$$\therefore \quad Wx = Ws(lx/ls)^{2.69}$$

The minimum number of snapper in the midden of site N38/37 is 20. Using the formula above, their total (gutted) weight is calculated to be 768 oz (21.8 kg). The minimum number of snapper in the midden of N38/30 is 11 and their total weight is 278 oz (7.9 kg). The average size of snapper in the midden of N38/37 was much larger than the average size of those in N38/30, i.e., 38 : 25 oz (1.1 : 0.7 kg). As with the difference in species distribution, this could possibly be explained as being due to different fishing techniques.

Bones tend to dissolve more quickly in an acid soil, especially if the soil is well drained. In an attempt to evaluate the preservative qualities of the soil at sites N38/37 and N38/30, pH tests were made of the three layers in three test pits. Test pit 1 was dug on the edge of site N38/37, near square K-12 (Fig. 1); test pit 2 was on a nearby unexcavated terrace on the same hill; and test pit 3 was on the flat swampy strip between the hill and the beach.

The natural clay of the three test pits was slightly alkaline, with pH readings between 5.6 and 6.7. The pH readings of layers 1 and 2, test pits 2 and 3, were similar, with an average pH of 6.2. Layer 2 from test pit 1, however, was much

more alkaline (pH 4.3), and the top soil was slightly more alkaline (pH 5.8). This is probably the result of the midden shell, present quite extensively in layer 2 of test pit 1. If the layers were alkaline or close to neutral in the past, as they seem to be today, they would have been favourable to bone preservation.

Results

Figure 1 shows the distribution of stone and shell in site N38/37. The stones were predominantly cooking stones and, as might be expected, were concentrated in those areas of the site where there were evidences of *haangi.*

One of the main problems of the archaeologist who attempts to reconstruct prehistoric activity from midden remains is to separate economic activity based on cultural preferences from that governed by environmental factors. The former transcends the immediate environmental situation, and is therefore useful in dating or describing a culture; the latter is particular to a certain site, is in a sense accidental, and is consequently of less archaeological value. Figure 2 shows that there was a decided preference for soft shore, rather than rocky shore mollusca at sites N38/37 and N38/30, but it is not clear whether such preference reflected cultural values or simply environmental exigencies.

Two types of rocky shore edible shellfish which cluster in colonies, and are relatively easy to obtain in large numbers, are mussels and rock oysters. They are available, though not extensively, on the present-day rocky shore at Station Bay, and are present in large numbers on the rocky beaches further south. If there was a preference for rocky shore mollusca (which could be met as they are available on nearby beaches), it is difficult to understand the absence of mussels and rock oysters from the midden material. Exploitation of the two species, as reflected in the midden was minimal (less than 10 examples of either species).

The mussels found in the midden were very small (under 5 cm long). Mussels growing on the rocky shore of Station Bay at the present time are of small size, which may indicate that conditions there do not favour the growth of many or large specimens. It is possible, however, that the small size and scarcity of mussels at Station Bay today, and in the midden from sites N38/37 and N38/30, are the result of past periods of local over-exploitation.

Figure 2 also shows that the greater part, in both number and weight, of the shell midden material from both sites is made up of soft shore bivalves. At site N38/37, pipi, *Amphidesma australe,* are the most common shellfish, and tuatua, *A. subtriangulatum,* are very rare. On site N38/30, tuatua are the most important mollusc and there is a corresponding lack of pipi. Cockles, *Chione stutchburyi,* are common on both sites. Most are of small size (one third of the cockles from site N38/37 are under 2 cm diameter), which implies indiscriminate gathering.

The nearest beach with tuatua is about three-quarters of a mile (1.2 km) from Station Bay; the most prolific source of cockles and pipi, the Motutapu-Rangitoto channel, is three miles (4.8 km) distant. At both sites N38/37 and N38/30, preference for soft shore mollusca was decided enough to outweigh the disadvantage of distance.

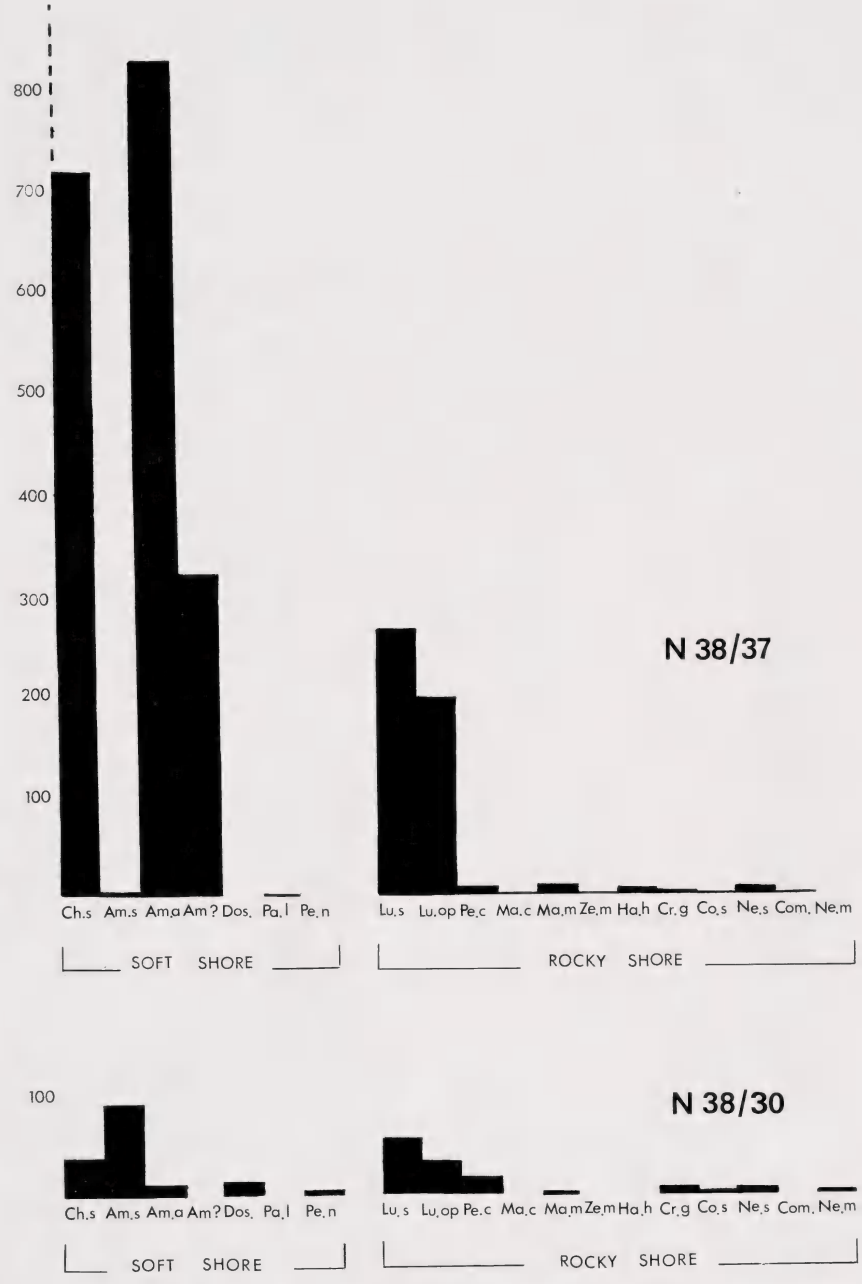

FIG. 2. Shell material in midden at sites N38/37 and N38/30, Station Bay. Horizontal axis—species of shells: Ch.s *Chione stutchburyi;* Am.s *Amphidesma subtriangulatum;* Am.a *Amphidesma australe;* Am? *Amphidesma* (broken); Dos. *Dosinia* sp.; Pa.l *Paphirus largillierti;* Pe.n *Pecten novaezelandiae;* Lu.s *Lunella smaragda;* Lu.op opercula of *Lunella smaragda;* Pe.c *Perna canaliculus;* Ma.c *Maoricrypta costata;* Ma.m *Maoricrypta monoxyla;* Ze.m *Zediloma morio;* Ha.h *Haustrum haustorium;* Cr.g *Crassostrea glomerata;* Co.s *Cookia sulcata;* Ne.s *Neothais scalaris;* Com. *Cominella?;* Ne.m *Nerita melanotragus.* Vertical axis—number of shells.

The inhabitants of site N38/37 seem to have favoured pipi as a staple shellfish food, while those of site N38/30 consumed tuatua. Such choice seems to be cultural preference rather than environmental necessity. Since the sites are close, and both are undefended, it is reasonable to assume that, if both were occupied contemporaneously, the inhabitants would share some bond of cultural identification, if not kinship identification, and would follow closely similar patterns of economic exploitation. Differences between the two sites are probably due, therefore, to separation in time rather than to cultural differences in two contemporaneous groups.

There was evidence in the midden of both sites that the pre-European inhabitants had exploited the excellent off-shore fishing grounds. The relative proportion (by weight) of fishbone to shell was 1 : 6, a ratio which gives no absolute measurement of the importance of fish as opposed to mollusc foods, but will give a comparative indication of the value of fish foods when similar proportional measurements are available from other sites.

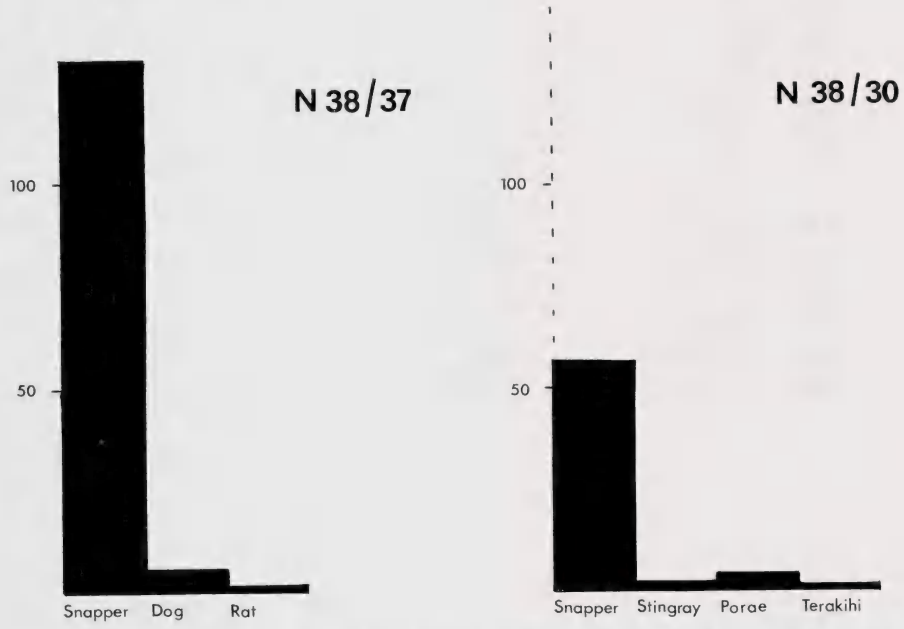

FIG. 3. Bone material in midden at sites N38/37 and N38/30. Horizontal axis—kind of bone; vertical axis—weight in grams.

Figure 3 shows that the main fish in the bone material is snapper; sting ray, porae and terakihi are also present, but probably only a single example of each. Dog and rat were also found, but near the surface and not associated with midden. They may represent post-occupation deposition.

The preponderance of snapper is probably due to the fact that the sites are near good snapper fishing grounds; also the bones of snapper are less fragile than those of such common fish as flounder and terakihi.

By means of the formula shown earlier, the approximate sizes and weights of snapper in the midden were calculated. Snapper from site N38/37 show a fairly even size/weight distribution. Out of 11 specimens present in the midden of site N38/30, however, it is estimated that 6 were under 11 inches (28 cm) long and weighed less than 7 ounces (198 g) (Fig. 4). Since Maori line fishing was designed for the catching of medium to large fish, it is possible that these small snapper were caught by the indiscriminate process of netting. The absence of fish-hooks from the two sites, and the wide range of species found in the midden of site N38/30, seem to reinforce this suggestion. Obviously, fish caught by nets would exhibit a wider range of species as well as size, than those caught by fish-hooks.

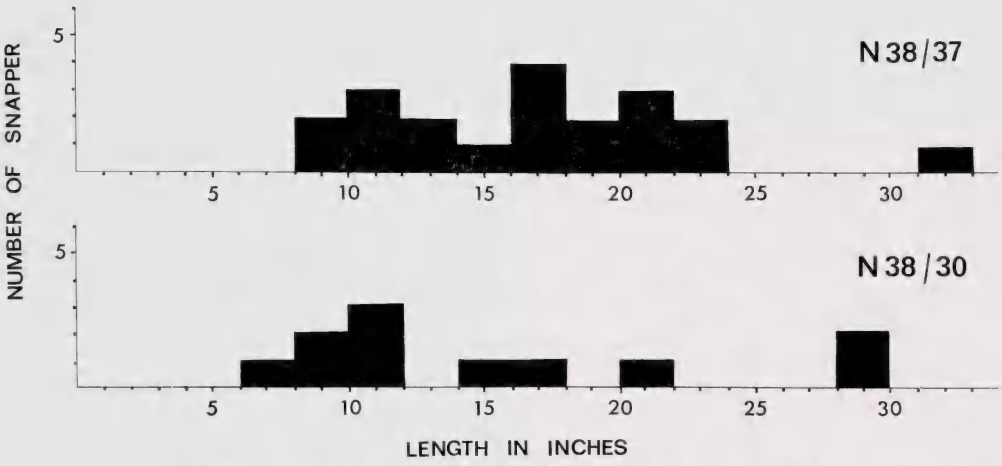

FIG. 4. Length of snapper in midden, sites N38/37 and N38/30.

It is possible that rays and other cartilaginous fish were more common as food than the evidence of a single sting ray spine would indicate. It is probable that the stings of rays were removed immediately they were caught (and therefore would not be present on the site), and certainly the cartilage of these fish could be expected to disintegrate quickly. At the present day, rays are quite common on the muddy platform off Station Bay, and sharks are often found there, particularly in summer.

Figure 5 shows that at Station Bay (as at Galatea Bay, Ponui Island—see Shawcross 1967, p. 113), there was a higher proportion of snapper head bones in the midden than body bones. This implies at least that the dismembering of snapper did not follow the European pattern of cutting off and throwing away the heads. Indeed, there is ethnographic evidence that fish heads were considered delicacies (Turei 1911, p. 25). In interpreting the differential occurrence of head and body bones at Galatea Bay, Shawcross (ibid. pp. 113-4) suggested four explanations:

that the jaws are the strongest bones and survive better . . .

that the excavators tend to select the head bones . . .

that dogs had scavenged the fish scraps . . .

that some degree of selection had been carried out on the site when the fish were being prepared:

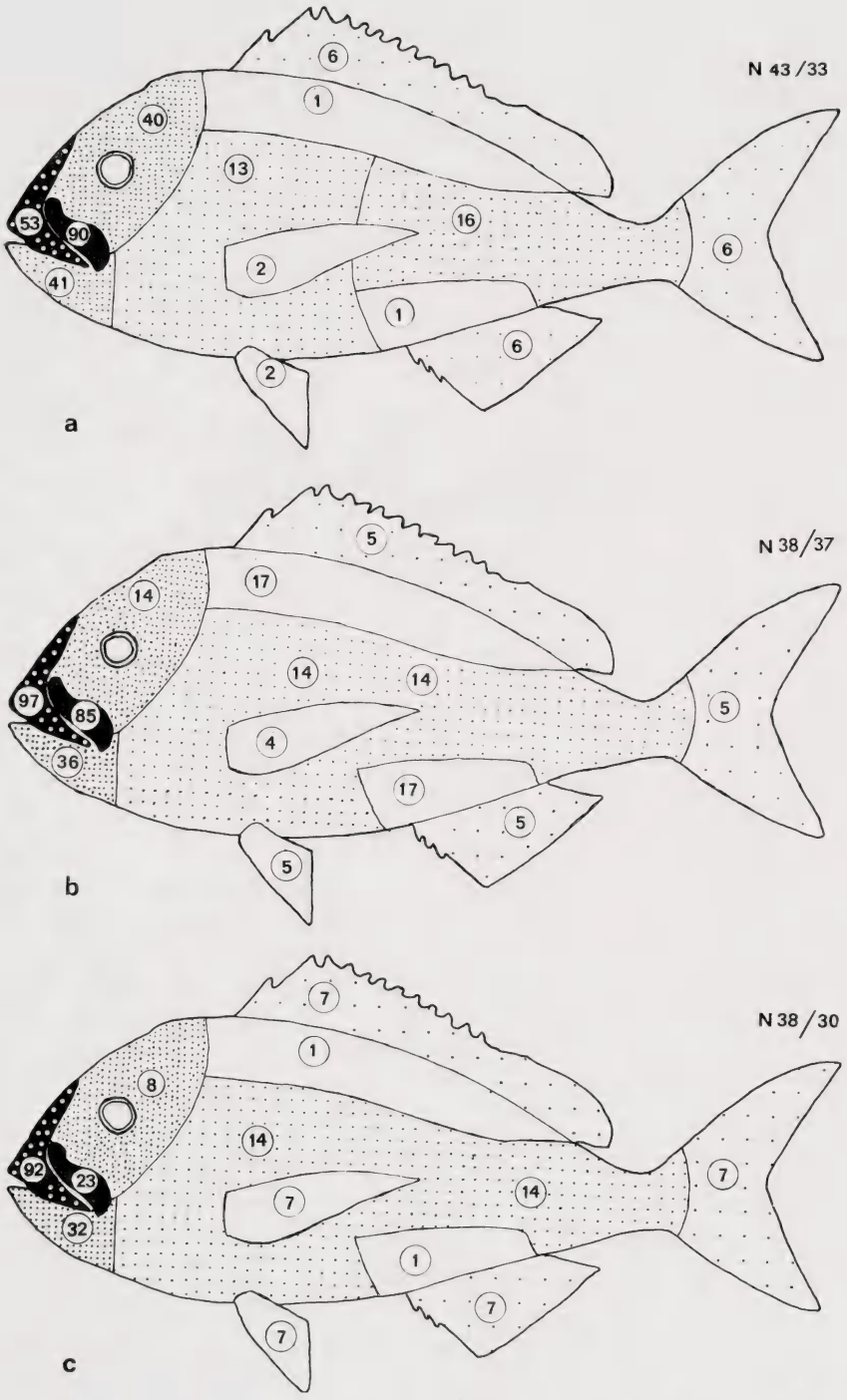

FIG. 5. Relative percentages of snapper bones in midden. a. Site N43/33, Galatea Bay, Ponui Island. Reproduced by courtesy of F. W. Shawcross. b. Site N38/37, Station Bay, Motutapu Island. c. Site N38/30, Station Bay, Motutapu Island.

> "The heads may have been separated from the trunks on the site, where all of them, but only some of the trunks, were eaten, leaving perhaps three-quarters of the trunks to be preserved by drying and subsequently taken elsewhere for consumption at another season."

The simplest explanation is that the relative scarcity of body bones is due to differential survival. Although the pH tests indicated a non-acid soil favourable to bone preservation, the dissolution of the bones over time would only be slowed and not halted completely. Most of the vertebrae consisted only of a centrum. The apophyses had been detached and either had dissolved or were not collected. This dissolution of the vertebral apophyses would be matched by the disappearance of at least some of the interneural and epipleural spines which are similar in size and construction. Similarly, there are dorsal spines in the midden—the fins had not been detached before bringing the fish to the sites, but no dorsal rays which would have been among the first parts to dissolve.

The second obvious factor is the greater ease of collection of head bones in excavation as they are generally larger and more easily recognisable than body bones. No sieves were used, and the collection of small bones in these circumstances was subject to the selectivity, conscious or unconscious, of the excavators.

There is no archaeological evidence that the occupants of sites N38/37 and N38/30 traded the fish bodies or took them elsewhere to consume. The flaking floor at site N38/30, and the extensive structural remains at site N38/37, imply that they were not specialised fishing camps. It is likely that fish caught by the occupants were eaten at the sites, not elsewhere. The predominance of head bones over body bones of snapper can be explained adequately by the factors of differential survival, and selection by the excavator, and is probably a common feature of coastal middens.

Conclusions

The midden of sites N38/37 and N38/30 was not extensive enough to produce other than tentative conclusions. It has indicated some patterns of economic activity. Sea foods rather than land-dwelling birds were used as a source of protein; there was a preference for soft shore rather than rocky shore mollusca, pronounced enough to outweigh the disadvantage of distance. There seems to have been a tendency to exploit snapper rather than other harbour fish, but this was probably due to their abundance rather than to any preference. Differences in the shellfish consumed suggest that the two sites were occupied at different times, a possible relationship that was not indicated by the structural and artifactual evidence.

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